Santa Clara Valley Water District

5750 ALMADEN EXPWY
SAN JOSE, CA 95118-3686
TELEPHONE (408) 265-2600
FACIMILE (408) 266-0271
www.valleywater.org
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August 28, 2006

Mr. Roger Briggs
Central Coast Water Board
895 Aerovista Place, Ste. 101
San Luis Obispo, CA 93401

Subject: Comments on the June 30, 2006 Llagas Subbasin Cleanup Feasibility Study – Olin/Standard Fusee Site, 425 Tennant Road, Morgan Hill, California

Dear Mr. Briggs:

The Santa Clara Valley Water District (District) has reviewed the Central Coast Regional Board's CAO No. R3-2005-0014 Ordering Section J – Llagas Subbasin Cleanup Feasibility Study, and Olin's "Cleanup Feasibility Study Report" submitted on June 30th 2006. The District recommends that the Water Board reject Olin's submittal as non-responsive.

Olin's submittal does not evaluate basinwide cleanup alternatives as required, nor does the report address all relevant beneficial uses of groundwater. Olin has prepared a detailed analysis of only two possible alternatives -- no further action at all or only monitoring of perchlorate attenuation – while summarily rejecting any active remedial measures by Olin. Olin has not identified or presented a detailed analysis of an adequate number of active remedial alternatives. On the basis of this inadequate feasibility study, it is unacceptable to propose a "do-nothing" approach for perchlorate occurring in drinking water wells at concentrations up to four times in excess of the current operative water quality criterion. The report contains a great many deficiencies, omissions, and unsupported arguments and does not satisfy the requirements or intent of the Water Board's Feasibility Study process.

Olin gives the Water Board an all-or-nothing approach, concluding that because Olin finds it too expensive to treat all the groundwater, it will therefore do nothing more than periodically monitor wells in the basin, a task which Olin is already required to do. Even in the maximum effort alternative, Olin does not propose to restore basin groundwater conditions to the background conditions that preceded the perchlorate contamination from its facility. The District recommends that the Water Board direct Olin to prepare a report in a manner that follows the CAO requirements, contains a detailed analysis of a range of feasible alternatives employing active remedial measures, and identifies feasible solutions to the contamination it has caused, which has affected the property owners, growers and groundwater resources in the Llagas subbasin. The District believes that the Regional Board's feasibility study process will only be served once Olin provides details on several feasible alternatives that address the optimum remedial effort, based upon a Cleanup Level that meets the requirements of State Board Resolutions 92-49 and 68-16, i.e., cleanup to Background.

The District's review comments for the Cleanup Feasibility Study are attached.

Sincerely,

[Original signed by]

Walt Wadlow
Chief Operating Officer
Water Utility

Cc: Suzanne Muzzio, Santa Clara County Environmental Health Department
Greg van Wassenhove, Santa Clara County Agricultural Commissioner
Jim Ashcraft, City of Morgan Hill Public Works Director
Carla Ruigh, City of Gilroy Community Services Director
Sylvia Hamilton, Perchlorate Community Advisory Group
B. Ahmadi, M. Richardson, K. Whitman, T. Mohr

District's review comments for the Cleanup Feasibility Study

The June 30, 2006 Cleanup Feasibility Study Report (CFS) submitted by Olin Corporation (Olin) does not provide for Background Concentration as it is required by State Water Board Resolution 92-49. Absent a substantive effort to quantitatively establish the background concentration, the Central Coast Water Board should consider using an Interim Background level, until a better definition of Background becomes available. The District recommends that the Water Board consider using 2 parts per billion as the Interim Background Concentration, since that is the level to which the Department of Health Services requires treatment for distribution of treated groundwater to the City of Morgan Hill's water system.

Olin's submittal does not evaluate basinwide cleanup alternatives as required, nor does the report address all relevant beneficial uses of groundwater. Olin has prepared a detailed analysis of only two possible alternatives – no further action at all or only monitoring of perchlorate attenuation – while summarily rejecting any active remedial measures by Olin. Olin should be required to submit a new Cleanup Feasibility Report that contains a detailed analysis of several feasible alternatives that address the optimum remedial effort and all relevant beneficial uses of groundwater, based upon a Cleanup Level that meets the requirements of State Board Resolutions 92-49 and 68-16, i.e., cleanup to Background.

SWRCB Resolution 92-49

In the CFS, Olin interprets State Water Resources Control Board (SWRCB) Resolution 92-49 to allow a cleanup level greater than background for its release of perchlorate into the Llagas groundwater subbasin. A cleanup level higher than background concentrations pertains to those situations where contaminants would not impair beneficial uses such as the "Containment Zone" provisions of 92-49. The circumstance of Olin's release of perchlorate into a sole-source drinking water aquifer is definitely not one of the situations where the "Containment Zone" provisions can be applied.

Olin has not yet begun cleaning up the basin, but is already seeking to obtain a Cleanup Level higher than background. Olin arbitrarily uses the US EPA Preliminary Remediation Goal (PRG) of 24.5 parts per billion (ppb) to define the "Plume Core", and then proposes an as-yet unspecified remedy for areas where perchlorate exceeds 24.5 ppb. Olin's proposed use of the EPA PRG is unsupported and inappropriate for a number of reasons, including the fact that the current Public Health Goal (PHG) in the State of California is 6 ppb.

SWRCB Resolution 92-49 provides detailed interpretation of the State Board's earlier Resolution 68-16, which is more commonly known as the California Antidegradation Policy. The SWRCB Resolution 92-49 requires that the Regional Water Boards adopt Orders and render decisions in a manner that maintains the highest water quality consistent with the maximum benefit to the people of the State:

> §4. *Regional Water Boards [are authorized] to require complete cleanup of all waste discharged and restoration of affected water to background conditions (i.e., the water quality that existed before the discharge);*
>
> §14. *Environmental damage may increase when a poorly conceived investigation or cleanup and abatement program allows pollutants to spread to previously unaffected waters of the state;*
>
> §26. *It is not the intent of the State or Regional Water Boards to allow dischargers, whose actions have caused, permitted, or threaten to cause or permit conditions of pollution, to avoid*

responsibilities for cleanup. However, in some cases, attainment of applicable water quality objectives for ground water cannot reasonably be achieved. In these cases, the State Water Board determines that establishment of a containment zone is appropriate and consistent with the maximum benefit to the people of the State if applicable requirements contained in the Policy are satisfied. The establishment of a containment zone does not limit or supersede obligations or liabilities that may arise under other laws;

Resolution II.A.9. *[The Regional Board shall] Prescribe cleanup levels which are consistent with appropriate levels set by the Regional Water Board for analogous discharges that involve similar wastes, site characteristics, and water quality considerations;*

III.H. *A containment zone is defined as a specific portion of a water bearing unit where the Regional Water Board finds, pursuant to Section III.H. of this policy, it is unreasonable to remediate to the level that achieves water quality objectives. . . . Examples of sites which may qualify for containment zone designation include, but are not limited to, sites where either strong sorption of pollutants on soils, pollutant entrapment (e.g. dense non-aqueous phase liquids [DNAPLS]), or complex geology due to heterogeneity or fractures indicate that cleanup to applicable water quality objectives cannot reasonably be achieved.*

III.H.1. *In establishing a containment zone, the following procedures, conditions, and restrictions must be met:*

b. Economic feasibility is an objective balancing of the incremental benefit of attaining further reductions in the concentrations of constituents of concern as compared with the incremental cost of achieving those reductions. The evaluation of economic feasibility will include consideration of current, planned, or future land use, social, and economic impacts to the surrounding community including property owners other than the discharger. Economic feasibility, in this Policy, does not refer to the discharger's ability to finance cleanup. Availability of financial resources should be considered in the establishment of reasonable compliance schedules;

III.H.2. e. *The proposed management plan must provide reasonable mitigation measures to substantially lessen or avoid any significant adverse environmental impacts attributable to the discharge. At a minimum, the plan must provide for control of pollutants within the containment zone such that water quality objectives are not exceeded outside the containment zone as a result of the discharge.*

III.H.3. a. *In no event shall the size of a containment zone or the cumulative effect of containment zones cause a substantial decline in the overall yield, storage, or transport capacity of a ground water basin;*

III.H.3. d. *A containment zone shall not be designated in a critical recharge area.*

These and other provisions of SWRCB Resolution 92-49 are similar to and consistent with the District Board of Directors' Ends Policy 2.1.6., which states, *"The groundwater basins are aggressively protected from contamination and the threat of contamination."*

The District has weathered significant groundwater contamination cases. The District teamed with the San Francisco Bay Water Board and US EPA to pursue identification and cleanup of solvent contamination from electronics, heavy industry, and military facilities throughout Santa Clara County beginning in the 1980's, the most notable examples of which include:

- the Fairchild case, in which a three mile plume of chlorinated solvents has been completely remediated except for a source area within a slurry cut-off wall;

- the IBM case, in which a four mile plume of chlorinated solvents has been entirely cleaned up in the period 1979 through 2006, with only a small area and some source zones remaining;
- the ongoing and well-known large-scale cleanup cases Moffett Field, Middlefield-Ellis-Whisman, Hillview-Porter, California-Olive-Emerson, Mohawk Chemical, Jones Chemical, Great Western Chemical, Jasco Chemical, Van Waters and Rogers, United Defense, United Technologies, Raytheon, Lockheed, Westinghouse, Northrup Grumman, National Semiconductor, Intel, NEC Electronics, Philips Electronics, Applied Materials, Advanced Micro Devices, Signetics, Intersil, American Micro Devices, TRW Microwave, Varian, Teledyne-Singer, Ampex, Anadite, twelve Hewlett Packard Sites, Magnetic Peripherals, Micrel/Litronix, Siliconix, and a number of major landfill sites.

The District's experience with these cases provides evidence that groundwater cleanup is an achievable goal. The IBM and Fairchild cases, which involved recalcitrant and elusive contaminants in the DNAPL[1] category, have achieved complete removal of many square miles of off-site contamination. The Water Board aggressively pursued cleanup, and ensured that further damage to drinking water supplies was prevented. These cases serve as proof that perchlorate can be effectively remediated to background in the Llagas groundwater subbasin. Cleanup of perchlorate may be somewhat easier because of its high solubility and low affinity to adsorb to the mineral framework of aquifer sediments, i.e., perchlorate is more easily removed from the aquifer than chlorinated solvents.

The above sections of SWRCB Resolution 92-49 indicate that the Water Board should reject Olin's request to establish a Cleanup Level higher than Background. Olin presents its arguments for a 24.5 ppb Cleanup Level in Section 4 of the CFS. In the following paragraphs, a partial list of the incorrect and/or unsupported statements and conclusions in Olin's CFS report is provided:

1. Olin initially presents four cleanup alternatives, two of which involve active remediation. Based on an inadequately supported screening process, Olin concludes that one of these is technically infeasible (in situ bioremediation for Areas I, II, III, and IV), and the remaining proposal for active cleanup, pump and treat, is presented as a full-scale build-out including 80 pumping wells, miles of piping, tanks, multiple treatment units, and recharge ponds, and costing $285 million over 75 years. Olin dismisses this option as economically infeasible without offering any detailed analysis of this alternative. Olin fails to identify and provide a detailed analysis of a range of active remedial alternatives that would be economically feasible and otherwise comply with applicable requirements. Olin's summary dismissal of any active remedial measures does not present the Water Board with a choice of the optimal level of cleanup effort required to make a material improvement to basin water quality.

   Additionally, Olin has presented no remedial baseline, i.e., the rate at which perchlorate can be expected to diminish if no action is taken. With an acceptable analysis of remedial baseline, the Water Board could weigh cleanup options with a reference frame for how much faster cleanup could be achieved than the passive long-term dispersion and dilution approach provided by Olin's preferred Monitored Attenuation option for Areas II, III, and IV.

[1] "*DNAPL" = Dense Non-Aqueous Phase Liquids, which are difficult to remediate because of their limited solubility and tendency to descend deep into aquifers because they are heavier than water.*

Recommendation: The District recommends that the Water Board require Olin to (1) identify and conduct a detailed analysis of a range of feasible remedial alternatives that employ active remedial measures by Olin, and (2) provide a remedial baseline by which the cleanup options can be objectively analyzed and evaluated.

2. Olin states that the Cleanup Level should be 6 ppb, however the report indicates that remediation will only be implemented in locations where concentrations exceed 24.5 ppb. For all intents and purposes, Olin proposes no cleanup action below 24.5 ppb. Furthermore, neither concentration level is the Background or an acceptable cleanup level for the Llagas groundwater subbasin.

   Recommendation: The District requests that the Water Board establish a Cleanup Level equivalent to the perchlorate Background concentration.

3. Olin proposes that "*Monitored Attenuation*" will address the areas where perchlorate is less than 24.5 ppb, based upon Olin's interpretation that concentrations of perchlorate may be decreasing, as described in Olin's March 30th Basin Characterization Report. The Second Quarter 2006 Monitoring report filed by Olin on July 30th indicates that, of 362 wells in which a majority of the test results in the last four quarters exceed 6 ppb, 74 percent had stable, unchanging, or indeterminate trends, while 20% had decreasing or probably decreasing trends, and 6 percent had increasing or probably increasing trends. Therefore, Olin's assertion, that Monitored Attenuation will achieve a decrease in perchlorate concentrations, is supported by only 20% of the wells and thus contradicted by 80% of the wells.

   Olin's basis for concluding that there are decreasing trends is rather mixed. Figure 1, presented in the list of omissions, below, shows that on an areal basis, about 13% of the area within which enough monitoring has been done to establish trends is apparently decreasing, while trends are indeterminate in up 81% of the area. We refer to the trends as "*apparent*" because the number of data points used to determine trend varies by well. While the trend over the last three years may be decreasing, in some wells, each of the last three data points has been higher than the previous data point. Using only Olin's trend determinations, no conclusions regarding trend can be drawn for three quarters of the monitored wells. The premise that Monitored Attenuation will result in lowering of perchlorate concentrations is based upon interpretive statistics. No mechanism or rate for perchlorate elimination has been proposed, and no quantitative estimate is provided for the time it will take for perchlorate to dissipate under current conditions.

   Recommendation: The District requests that the Water Board require Olin to provide a quantitative analysis validating the basis for the "Monitored Attenuation" approach.

4. The California Anti-degradation Policy, as enumerated in SWRCB Resolution 92-49, calls for consideration of all applicable and relevant water quality objectives. The CFS report does not address agricultural water quality objectives. The report does not acknowledge that perchlorate accumulates in numerous crops, and that the presence of perchlorate in irrigation water pumped out of Olin's plume may limit growers' crop options and marketing opportunities. Resolution 92-49 calls for "considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible".

According to the Santa Clara County Agricultural Commissioner's 2005 Crop Report, the direct economic value of Santa Clara County's crops was more than $250 million. Most of this value was derived from crops produced in the area impacted by Olin's perchlorate plume. This figure does not include agriculture's indirect economic value in the perchlorate-impacted portions of the Llagas groundwater subbasin, such as the farm labor employment, supporting businesses, and downstream markets.

Recommendation: The District requests that the Water Board require Olin to provide an analysis that identifies the Cleanup Level that will not impair agricultural beneficial uses.

5. The CFS report does not address ecological water quality objectives. Recent studies suggest that perchlorate has an endocrine disrupting effect on aquatic organisms (see e.g. Environmental Toxicology and Chemistry: No. 25, pp. 2087–2096).

   Recommendation: The District requests that the Water Board require that Olin review available ecotoxicological studies to analyze and support selection of protective Cleanup Levels that will not harm aquatic ecosystems in the streams, creeks, and wetlands in the Llagas Valley and points downstream. Olin should perform a risk assessment to address the narrative toxicological water quality objectives in the Basin Plan.

6. Olin's discussion of the 6 ppb PHG, the pending MCL, the 24.5 ppb federal PRG, and its earlier submittal of an 11 ppb Cleanup Level does not support its determination of a proposed Cleanup Level within the guidelines of SWRCB Resolution 92-49. The appropriate determination must be made in the context of Background levels of perchlorate. In Section 4.4, Olin states, "*anthropogenic sources contribute perchlorate to the Llagas Subbasin, which results in background perchlorate concentrations up to 4 µg/L*." Olin provides several examples of how perchlorate from other sources could be introduced to the groundwater basin; however, Olin fails to establish a cause and effect relationship through either calculation or sampling evidence to prove that these sources have contributed perchlorate to the Llagas Subbasin. While Olin has sampled wells and detected perchlorate at locations north of the site, it has not shown that the source of that perchlorate originates elsewhere, nor has it shown that the detections could not have originated from its facility.

   Recommendation: The District recommends that the Water Board cause Olin to investigate and provide quantitative sampling evidence (not calculations) for its claims that roadside flare residuals, bleach, or other potential sources of perchlorate have actually caused perchlorate groundwater contamination.

7. Olin cites (at page 34) a sentence in a District draft document that refers to staff opinion about the RWQCB's ability to require Olin to conduct a basin-wide study of background concentrations of perchlorate. This has no bearing on the RWQCB's authority in the Olin case. The District's study is intended to produce information that will ultimately be useful to the District for groundwater management and operational considerations, and that may also be useful to RWQCB's administration of the Olin case. However, the District's study is proceeding independently from the regulatory timeline. Olin must therefore continue investigating background conditions. Olin's groundwater flow measurements show northeast flow in the deep zone, and therefore Olin needs to expand its investigations to the north, west, and east to

establish background conditions relevant to determining the Background Level to which perchlorate must be remediated.

Recommendation: The District requests that the Water Board cause Olin to perform a quantitative analysis of the Background concentration of perchlorate for use in establishing the Cleanup Level. The District requests that the Water Board establish an Interim Cleanup Level equal to the lowest detected perchlorate concentrations in wells that the Water Board has confirmed are not contaminated by perchlorate originating from the Olin site, until Olin can provide a reasonable and acceptable analysis of Background concentration levels. The District understands that these detections are less than 2 parts per billion.

8. In Section 4.5, Olin describes cleanup levels established by Water Boards, US EPA, or the Department of Toxic Substances Control. The cleanup levels established at other sites are not applicable to the Olin case and are inappropriate under these circumstances. Olin's release of perchlorate has impacted more private drinking water wells than any other known perchlorate release in the entire United States. Table 4.1 reveals that none of the sites where drinking water wells have been impacted had the cleanup level equal to the PHG for the drinking water wells. Some sites have used the PHG as a property line cleanup level to protect downgradient drinking water wells. Most of the sites have not yet reached the point of establishing a cleanup level. At the site nearest to the Olin Case, the San Francisco Bay Water Board has set the cleanup level within the Pratt and Whitney/Rocketdyne property to 6 parts per billion. However, for all off-site groundwater and surface water, the cleanup level is "non-detect" to ensure protection of beneficial uses of surface water and groundwater.

   Recommendation: The District recommends that the Water Board consider the specifics of this case and its impact on drinking water wells and long term water supply reliability when establishing the Cleanup Level appropriate for the Llagas subbasin and all the associated beneficial uses.

9. Throughout the CFS report, Olin identifies the District's groundwater recharge program as the key factor contributing to reduction of perchlorate levels in the Llagas subbasin, upon which it relies for the "Monitored Attenuation" alternative. The unarticulated premise for "Monitored Attenuation" is that District recharge operations will continue indefinitely at a constant and beneficial level. Numerous factors related to operational requirements, budgets, capital costs, and water supply availability affects the artificial recharge operations in the Llagas subbasin. Moreover, Olin has not approached the District or reached any agreement with the District for continued operation of artificial recharge to benefit cleanup of perchlorate. It is therefore inappropriate for Olin to propose a remedy that relies entirely on operations that it does not control or has not sought to collaborate on.

   Recommendation: The District recommends that the Water Board require Olin to provide a supportable basis for the cleanup of perchlorate by "Monitored Attenuation".

UNSUPPORTED REGULATORY INTERPRETATIONS:

1) Olin has made much of the CAO's Ordering Paragraph J Item 7: "An evaluation of alternatives for plume core remediation". This is the only place in the CAO where the phrase "core" is used; it is not a defined term. Olin has capitalized on the absence of an official definition of this term to assert that the core of the plume is everything greater than EPA's Preliminary Remediation Goal (PRG), 24.5 ppb. The PRG is a federal guidance level that has no bearing on a Regional Board case.

2) Olin has arbitrarily and capriciously decided that it can map the plume core for the rest of this year, and then submit a report in January 2007. The time and place to submit a plume map was in the Characterization Study, CAO Ordering Section D, which was due March 30th, 2006. By submitting an incomplete and substandard Plume Characterization Work Plan, Olin obtained significant delay, so that there was little time between the date that the Water Board was provided with enough of a plan to issue partial approval, and the due date.

   The current report was to include a Cleanup Feasibility Study for the whole plume including the core. Olin submitted the Feasibility Study in two parts, with the second part addressing the plume core, which by Olin's arbitrary definition includes Area I. The Area I Feasibility Study is due August 30th by arrangements between Olin and the Water Board that were not shared with the Perchlorate Community Advisory Group, the Perchlorate Working Group, or the public. Olin must include a map of the plume core and a remedial feasibility analysis in that report. However, the plume core may not be limited to Area I if the Water Board decides that another basis for defining the plume core is more appropriate.

   Recommendation: The Water Board should determine the basis for establishing the Plume Core and require that the Area I Cleanup Feasibility Study report address all areas where perchlorate has been found in excess of the Water Board's Plume Core threshold.

OMISSIONS

#1 Olin has made reference to an apparent discontinuity in the distribution of perchlorate east of US 101. The CFS speculates that this feature may be due to:

- increased hydraulic conductivities in aquifer units east of US 101,
- regional recharge diluting perchlorate where the plume crosses US 101,
- a second source of perchlorate.

These possibilities could be further elucidated by bracketing the limits to perchlorate migration based on hydrogeologic constraints to groundwater flow rates. Olin has completed an extensive effort to obtain hydraulic conductivities from innovative slug tests performed during sonic drilling of fourteen new multi-port wells. The multi-port wells have yielded high resolution head profiles at different intervals within the aquifer, and Olin is collecting quarterly head data over an extensive network of private wells selected for their construction features. Nevertheless, Olin has thus far refrained from advancing an estimate of possible groundwater flow and perchlorate migration rates in either the Basin Characterization report or the CFS.

Table 1, below, approximates groundwater flow velocities based on Olin's conductivity, porosity, and gradient data. The data presented are taken from Olin's Basin Characterization Report. The following flow velocity calculations apply simplifying assumptions, while also ignoring 1) the effects of variable downward vertical gradient near the site and 2) discharging conditions toward the southern end of the currently mapped extent of perchlorate occurrence.

Region	Shallow	Upper Int	Lower Int	Deep	Representative Inferred Conductivity, K, ft/day	Approximate Horizontal Gradient, ft/ft (dh/dl)	Effective Porosity, n_e , from Table 5.2	Apparent Groundwater Flow Velocity, **v** ft/day (rounded to nearest foot/day)
Morgan Hill					200 ft/day	0.002	0.10	4 ft/day
San Martin					200 ft/day	0.004	0.13	6 ft/day
Gilroy					200 ft/day	0.002	0.13	3 ft/day
Morgan Hill					300 ft/day	0.0014	0.08	5 ft/day
San Martin					300 ft/day	0.0039	0.08	15 ft/day
Gilroy					300 ft/day	0.0029	0.20	4 ft/day
Morgan Hill					50 ft/day	0.0014	0.06	1 ft/day
San Martin					50 ft/day	0.0039	0.10	2 ft/day
Gilroy					50 ft/day	0.0029	0.06	2 ft /day
Morgan Hill					20 ft/day	0.002	0.07	0.6 ft/day
San Martin					20 ft/day	0.004	0.05	2 ft/day
Gilroy					20 ft/day	0.002	0.03	1 ft day

v = $(K \times dh/dl)/n_e$ = data not obtained from this zone; value interpolated from adjacent zones

We submit the above "back of the envelope" review of the data to profile the importance of advancing groundwater flow velocity estimates using simple, verifiable calculations.

Taking the geometric mean of roughly interpreted groundwater flow velocities in all aquifers, a regional groundwater flow velocity of 2.6 feet per day can be obtained. Taking the geometric mean of only the shallow and upper intermediate zones, a groundwater flow velocity of about 5.3 feet per day can be obtained.

For the former value, assuming perchlorate releases began in the first year of operations in 1956 and perchlorate continues to be released from fine grained soils in aquitard units to the present day, we get a plume length of about nine miles. For the latter value, under the same assumptions, perchlorate could potentially migrate a substantial distance south of Highway 152, i.e., further than the ten-mile plume mapped in Olin's reports.

Olin identifies an apparent discontinuity in perchlorate concentrations. However, Olin has detected perchlorate at concentration of close to 2,000 ppb in an off-site aquitard, which suggests an ongoing source. All of the currently mapped plume extent could originate from the Olin site, and it remains possible that perchlorate from the Olin site occurs south of Highway 152.

Recommendation: The Water Board should cause Olin to produce a verifiable calculation supported by field data to estimate reasonable groundwater flow and perchlorate migration rates in different portions of the basin.

#2 Olin has not estimated the remedial baseline. The Cleanup Feasibility Study has not provided an answer to the question, "What happens to the perchlorate that is now being pumped out of the aquifer and used for irrigation, domestic plumbing, household uses, etc.?" Instead, it assumes that mixing, dispersion or dilution is and will be responsible for all concentrations declines.

The approximate amount of perchlorate abstracted from the aquifers beneath the Areas II, III and IV discussed in the CFS Report can be calculated to a total approximating 70 pounds per year:

Area	Pumping	Pounds Perchlorate Removed Per Year
II	~220 Acre-Feet/yr	~2 pounds per year
III	~1,350 AF/yr	~15 pounds per year
IV	~5,200 AF/yr	~50 pounds per year

The perchlorate pumped out of the aquifer may all recirculate and infiltrate back into the aquifer, or some may be eliminated through biologic reduction in septic tanks, soils, or in pockets of anaerobic groundwater. The CFS posits that perchlorate in the shallow zone will be reduced through continuing irrigation, but does not describe the mechanism by which that reduction is achieved. Although uptake in crop biomass is one fate that will eliminate perchlorate from the aquifer, it may also complete a route of exposure. The CFS has failed to evaluate the fate of perchlorate in septic tanks, or whether any vadose zone processes might eliminate perchlorate.

The one instance in which perchlorate elimination from extracted groundwater is assured is on the treatment systems. Olin's monthly status reports only state the total gallons of water treated, without reporting the mass of perchlorate removed. From Olin's figures, the inference can be made that the West San Martin Water Works treatment units have removed only about five pounds of perchlorate ion since they were first equipped with treatment systems in 2003, while the San Martin County Water District Treatment units removed only about four pounds since startup.

It would be helpful to estimate the amount of perchlorate now being removed from the aquifer through all the ion exchange treatment systems installed on private wells and the two small water systems by Olin, and especially the treatment systems installed on municipal wells installed by the City of Morgan Hill, where the greatest mass removal is likely to occur.

Recommendation: 1) The Water Board should consider directing Olin to produce estimates of the remedial baseline, so that alternatives compared in a future, properly executed Cleanup Feasibility Study can be rated against a baseline.

2) The Water Board should consider directing Olin to revise its monthly reports to list the mass removed by each treatment unit.

#3 Olin has not estimated how much perchlorate is in the aquifer. Olin issued a memo to US EPA in November 1978, in which they report that annual usage of potassium perchlorate was 149,600 pounds per year. A September 1978 Olin staff memo explains that from 1955 until 1970, waste material, including potassium perchlorate, was buried in pits on the property. From 1970 until 1973, waste material was placed in an unlined trench and burned. Olin has a much more detailed knowledge of the site operating history, and is well-positioned to make a more accurate estimate of the probable mass of perchlorate released to the Llagas groundwater subbasin.

This year, Olin discovered from their investigations that aquitards near the site harbor large masses of perchlorate, producing the highest off-site concentrations found to date. Fine-grained materials may still hold a substantial reservoir of perchlorate that will sustain the plume for many years to come. In the District's December 19, 2003 Letter to the Water Board, the District indicated the importance of ascertaining the properties of aquitards with respect to fine-grained storage and back-diffusion to produce long-term 'plume-tailing'.[2] When a heterogeneous aquifer assemblage exhibits dual porosity effects, with the bulk of the pore

[2] The District's letter cited the reference, *In Situ* Remediation Engineering*, Suthan Suthersan and Fred C. Payne, CRC Press,* 2004.

volume residing in less conductive fine-grained sediments that are adjacent to more porous flow channels, perchlorate can be stored and act as a static contaminant reservoir for an extended period of time, resulting in plume longevity that may rival that of a chlorinated solvent release.

Recommendation: 1) The Water Board should consider directing Olin to produce estimates of the mass of perchlorate released to the Llagas groundwater subbasin through all pathways, based on knowledge of the facility's operating history.

2) The Water Board should consider directing Olin to produce estimates of the mass of perchlorate residing in the transmissive aquifer materials as well as the mass of perchlorate stored in the fine-grained deposits, and to provide an analysis of whether perchlorate residing in the fine-grained deposits will act as a long term source.

#4 Olin has omitted the wells with perchlorate detections located outside Areas I, II, III, and IV. Wells in the Northeast Study Area, and wells located to the east and west of the designated areas, are arbitrarily excluded from consideration for cleanup. There are more than 150 wells with perchlorate detections outside Olin's designated areas. In the results *reported in the 2nd Quarter 2006 Monitoring report,* more than 30 wells located outside Olin's designated areas have a detection of 4 ppb or greater.

Olin's basis for designating Areas I, II, III, and IV is the concentration of perchlorate in wells in each area. Perchlorate concentration is a transient parameter. Defining areas based on results at a single point in time will invariably lead to those areas failing to account for some wells outside the areas.

Instead of designating areas based on concentrations, a more appropriate approach would be to determine a cleanup plan based on which technologies are best-suited for different concentration ranges. It is unlikely that all the wells within Areas I, II, III, and IV (1 square mile, 1.4 square mile, 5 square miles, and 6.3 square miles, respectively) can appropriately be addressed using a one-size fits all remedy, unless the selected remedy removes all perchlorate.

The CFS should evaluate the alternative of eliminating perchlorate from all ongoing groundwater pumping by installing wellhead treatment on all affected wells. This approach could protect existing beneficial uses of water and between 60 and 70 pounds of perchlorate per year could be removed. The cost of equipping all impacted wells with treatment units could be less than $45 million in a 30 year operating timeframe (assuming $15,000 initial capital costs per well and $2,000 per year operating costs, based on figures presented by Olin to the Perchlorate Community Advisory Group). This remedy would need to be augmented by targeted extraction in areas with higher perchlorate mass to accelerate basin restoration.

Recommendation: 1) The Water Board should consider directing Olin to abandon the Area designations, and instead devise a Cleanup Feasibility Study that addresses all of the perchlorate plume as delineated by the sum of all monitoring performed to date. The Water Board should prohibit Olin from carving out some portions of the plume and abandoning others. 2) The Water Board should consider directing Olin to prepare a detailed analysis of the "Treat All Wells" remedial alternative, in a future, properly prepared Cleanup Feasibility Study.

#6 The CFS Report neglects to account for agricultural pumping in the feasibility analysis (Chapter 7). While the report elsewhere mentions that agricultural pumping is the greatest portion of all pumping, for the feasibility analysis, the report states:

"*The current volume extracted from all supply wells in the Llagas Subbasin is approximately 20,000 AF.*"

This figure only accounts for domestic, municipal, and industrial pumping, and neglects agricultural pumping, which comprises at least an additional 20,000 acre-feet.

#7 In its statements summarizing concentration trends in wells, Olin has neglected to account for how much plume area each monitored well represents. The premise for "Monitored Attenuation" is that perchlorate concentrations appear to be decreasing in the majority of wells for which Olin has done a statistical analysis of trend. However, the majority of the plume area occupied by wells for which trend analysis can be completed does not have a decreasing trend.

Olin states the following in the CFS Report at page C-3:

6 wells have increasing or probably increasing perchlorate concentration trends
95 wells have decreasing or probably decreasing perchlorate concentration trends
201 wells have either no trend or are stable.

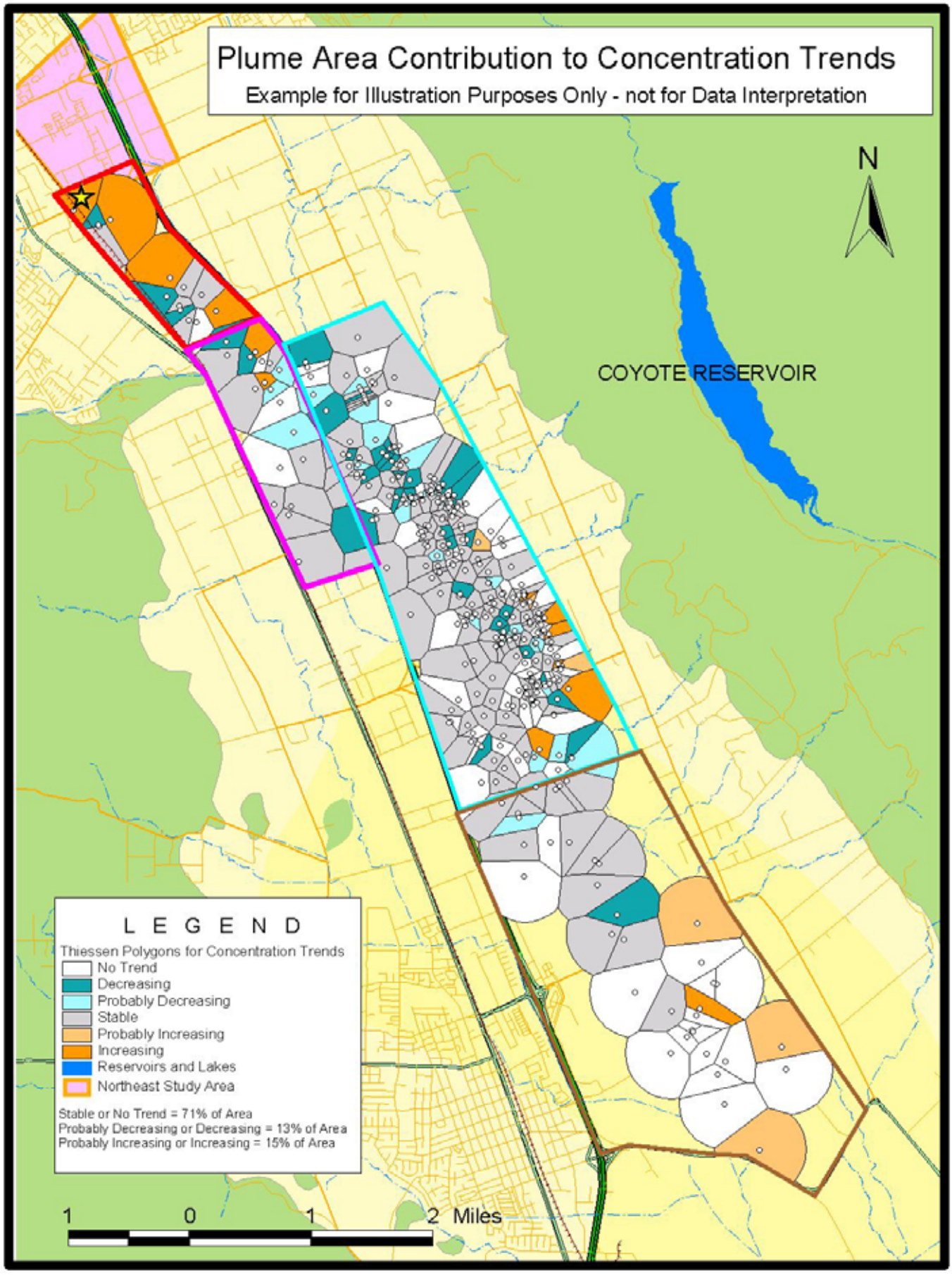
A review of the map reveals that counting a group of wells that are spaced close together and apparently decreasing should not carry the same weight as wells spaced further apart. If the data are "declustered", a different picture emerges (see Figure below.) In the declustered data for the Second Quarter Monitoring Report, the majority of wells have stable trends or no discernible trends, as was found by counting the raw data. However, when accounting for area, perchlorate concentrations in approximately 13% of wells in the declustered data are decreasing, while concentrations in approximately 15 % of the wells in the declustered data are increasing

For illustration purposes, the Figure below presents a simplistic method to decluster the data using Thiessen Polygons.[3] This allows viewing the trends by the number of acres represented by each well for which trend analysis was executed by Olin.

This example does not account for variations in depth, pumping, concentration range, or statistical features; nor does it present an error-free or complete analysis. However, this alternative way to view the trends suggests that Olin's practice of counting wells without consideration of area may introduces a significant bias.

Recommendation: The Water Board should consider directing Olin to present the concentration trend data for purposes of plume analysis in a manner that accounts for the effects of data clustering.

[3] A Thiessen or Voronoi polygon is formed by drawing a line from a well to each surrounding well. The midpoints of the lines are found and lines perpendicular to those lines are drawn at their midpoints and extended until they intersect the perpendicular to the adjacent line. In this rough example, areas may be exaggerated by clipping to the Area I, II, III and IV boxes or a fixed distance buffer zone around the wells with available trends. This example should not be used for data interpretation – it is for illustration purposes only.


Plume Area Contribution to Concentration Trends
Example for Illustration Purposes Only - not for Data Interpretation
N
COYOTE RESERVOIR
LEGEND
Thiessen Polygons for Concentration Trends
No Trend
Decreasing
Probably Decreasing
Stable
Probably Increasing
Increasing
Reservoirs and Lakes
Northeast Study Area
Stable or No Trend = 71% of Area
Probably Decreasing or Decreasing = 13% of Area
Probably Increasing or Increasing = 15% of Area
1 0 1 2 Miles